

1 Combinatorics

	With Replacement	Without Replacement
Permutations (Ordered)	$P_r(n, k) = n^k$	$P(n, k) = \frac{n!}{(n-k)!}$
Combinations (Unordered)	$C_r(n, k) = \binom{n+k-1}{k} = \frac{(n+k-1)!}{k!(n-1)!}$	$C(n, k) = \binom{n}{k} = \frac{n!}{k!(n-k)!}$

2 Distributions

Distribution	Moments	Bernoulli	Binomial	Geometric	Poisson	Exponential	Uniform	Normal
PDF		$p^x(1-p)^{1-x}$	$\binom{n}{x}p^x(1-p)^{n-x}$	$(1-p)^{x-1}p$	$e^{-\lambda} \frac{\lambda^x}{x!}$	$\frac{1}{\lambda} e^{-\frac{x}{\lambda}}$	$\frac{1}{b-a}$	$\frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$
E[X]	$\bar{X} = \frac{1}{n} \sum_{i=1}^n X_i$	p	np	$\frac{1}{p}$	λ	λ	$\frac{a+b}{2}$	μ
Var[X]	$E[X^2] = \frac{1}{n} \sum_{i=1}^n (X_i - \bar{X})^2$	$p(1-p)$	$np(1-p)$	$\frac{1-p}{p^2}$	λ	λ^2	$\frac{(b-a)^2}{12}$	σ^2

3 Hypothesis Testing

H ₀	H _A	Conditions	Test Statistic	Rejection Region	Degrees of freedom
$\mu_1 = \mu_2$	$\mu_1 < \mu_2$ $\mu_1 > \mu_2$ $\mu_1 \neq \mu_2$	Known σ	$Z = \frac{(\bar{X}_1 - \bar{X}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$	$Z < -z_{\alpha}$ $Z > z_{\alpha}$ $ Z > z_{\alpha/2} $	
$\mu_1 = \mu_2$	$\mu_1 < \mu_2$ $\mu_1 > \mu_2$ $\mu_1 \neq \mu_2$	Unknown but equal σ $s^2 = \frac{1}{n-1} \sum_{i=1}^n (x_i - \bar{x})^2$ $s_p^2 = \frac{(n_1-1)s_1^2 + (n_2-1)s_2^2}{n_1+n_2-2}$	$t = \frac{(\bar{X}_1 - \bar{X}_2) - (\mu_1 - \mu_2)}{\sqrt{s_p^2 (\frac{1}{n_1} + \frac{1}{n_2})}}$	$t < -t_{df, \alpha}$ $t > t_{df, \alpha}$ $ t > t_{df, \alpha/2} $	df = $n_1 + n_2 - 2$
$\pi_1 = \pi_2$	$\pi_1 < \pi_2$ $\pi_1 > \pi_2$ $\pi_1 \neq \pi_2$	Z-test for proportions	$Z = \frac{(\hat{\pi}_1 - \hat{\pi}_2) - (\pi_1 - \pi_2)}{\sqrt{\frac{\hat{\pi}_1(1-\hat{\pi}_1)}{n_1} + \frac{\hat{\pi}_2(1-\hat{\pi}_2)}{n_2}}}$	$Z < -z_{\alpha}$ $Z > z_{\alpha}$ $ Z > z_{\alpha/2} $	
$\beta_1 = 0$	$\beta_1 \neq 0$	Test for linear relationship	$t = \frac{\hat{\beta}_1 - \beta_1}{\sqrt{\frac{s^2}{S_{xx}}}}$	$t > t_{df, \alpha/2} $	df = $n - 2$

4 Linear Regression Formulas

$$\hat{\beta}_0 = \bar{y} - \hat{\beta}_1 \bar{x} \quad (1)$$

$$\hat{\beta}_1 = \frac{S_{xy}}{S_{xx}} \quad (2)$$

$$S_{xx} = \sum_{i=1}^n (x_i - \bar{x})^2 \quad (3)$$

$$S_{xy} = \sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y}) \quad (4)$$

$$SS_{RESID} = \sum_{i=1}^n (y_i - \hat{y})^2 \quad (5)$$

$$RegressionVariance : s^2 = \frac{SS_{RESID}}{n-2} \quad (6)$$

$$NormalEquations : \left\{ \begin{array}{l} \sum_{i=1}^n (y_i - \beta_0 - \beta_1 x_i) = 0 \\ \sum_{i=1}^n x_i (y_i - \beta_0 - \beta_1 x_i) = 0 \end{array} \right\} \quad (7)$$